# a black-hole electron model and the physical constants

In the "Trialogue on the number of fundamental physical constants" was debated the number, from 1 to 3, of dimensionful units required. There was also a distinction made between dimensionful and dimensionless constants. In this article, using a black-hole electron model, I argue that this distinction may be artificial in that the dimensionful constants may be constructed from the dimensionless constants unto which a dimensionality has been conferred, possibly via rotation. From this model I derive $G, h, e, c, m_e, k_B$ as geometrical forms constructed from 2 dimensionless numbers; the Sommerfeld fine structure constant $\alpha$ and a proposed $\Omega$, and 2 dimensionful scalars. By assigning appropriate numerical values to these 2 scalars we may solve the dimensionful physical constants for any chosen system of units, whether human or non-terrestrial, the mathematical constants $(\alpha, \Omega)$ remaining fixed in value. A dual-state electron is proposed that periodically oscillates between a dimensionful magnetic monopole ($\sigma_e$, ampere-meter AL units = $s^{-1/3}$) 'electric-state' that when combined with Planck time (T, units = $s$), collapses into a (T$\sigma_e^3$, units = $s/s$ = 1), dimensionless 'point-state' with the characteristics of a Planck black-hole suggesting a Planck-unit theory. The dimensionless geometries of mass M=1, time T=$2\pi$, length L=$2\pi^2\Omega^2$ suggest that an angular motion may be the means by which dimensionality is conferred, a key condition for a mathematical universe hypothesis. The gravitational coupling constant formula suggests that gravity is an interaction between the dimensionless point-states, if so then gravity has a magnitude consistent with the strong force and thus arguably is a discrete black-hole to black-hole interaction. The square root of Planck momentum is used to link the charge constants with the mass constants, this permits us to re-define SI $G, h, e, m_e, k_B$ values in terms of the 4 most accurate SI constants; $c$, $\mu_0$ (exact values), fine structure constant alpha (10-11 digits precision) and the Rydberg constant (12-13 digits precision), results are consistent with CODATA 2014.

| | Calculated $(R, c, \mu_0, \alpha)$ [8] | CODATA 2014 |
|---|---|---|
| speed of light | (299792458) | $c$ = 299792458 (exact) |
| Fine structure constant | (137.035999139) | $\alpha$ = 137.035 999 139(31) [16] |
| Rydberg constant | (10973731.568508) | $R_\infty$ = 10 973 731.568 508(65) [14] |
| Planck constant | $h^*$ = .662 606 913 413 e-33 | $h$ = .662 607 004 0(81) e-33 [15] |
| Elementary charge | $e^*$ = .160 217 651 130 e-18 | $e$ = .160 217 662 08(98) e-18 [17] |
| Vacuum permeability | $(4\pi/10^7)$ | $\mu_0 = 4\pi/10^7$, (exact) [19] |
| Electron mass | $m_e^*$ = .910 938 231 256 e-30 | $m_e$ = .910 938 356(11) e-30 [18] |
| Boltzmann's constant | $k_B^*$ = .137 951 014 752 e-22 | $k_B$ = .138 064 852(79) e-22 [21] |
| Larmor frequency | $f_L$ = 28 024.953 551 | $f_L$ = 28 024.951 64(17) [23] |
| Gravitation constant | $G^*$ = .667 249 719 229 e-10 | $G$ = .667 408(31) e-10 [20] |
| Von Klitzing constant | $R_K^*$ = 25 812.807 455 591 | $R_K$ = 25 812.807 455 5(59) [22] |
| Bohr magneton | $\mu_B^*$ = .927 400 936 03e-23 | $\mu_B$ = .927 400 999 (57)e-26 [24] |

keywords: Mathematical Universe Hypothesis, fundamental physical constants, fine structure constant alpha, Omega, black-hole electron, wave-particle duality, Dirac-Kerr–Newman electron, Planck unit theory;

## 1 Background

*Mathematical realism* holds that mathematical entities exist independently of the human mind. Thus humans do not invent mathematics, but rather discover it, and any other intelligent beings in the universe would presumably do the same. The mathematical universe hypothesis (MUH) is a "theory of everything" proposed by cosmologist Max Tegmark [13].

*Planck units* are a set of natural units of measurement defined exclusively in terms of five universal physical constants, in such a manner that these five physical constants take on the numerical value of $G = hbar = c = 1/4\pi\epsilon_0 = k_B = 1$ when expressed in terms of these units. These units are also known as natural units because the origin of their definition comes only from properties of nature and not from any human construct.

"we get the possibility to establish units for length, mass, time and temperature which, being independent of specific bodies or substances, retain their meaning for all times and all cultures, even non-terrestrial and non-human ones and could therefore serve as natural units of measurements..."
-Max Planck [13].

## 2 Geometry of the physical constants

A physical constant is a physical quantity that is generally believed to be both universal in nature and having constant value in time. It is contrasted with a mathematical constant, which has a fixed numerical value, but does not directly involve any physical measurement.

This article describes a model of a dual state electron that oscillates between a physical (*dimensionful*) time T and magnetic monopole $\sigma_e$ electric-state and a (*dimensionless*) mathematical-state (units=1).

$$f_e^{-1} = \frac{\sigma_e^3}{T} = 4\pi^2 r^3 \; (r = 2^6 3\pi^2 \alpha\Omega^5); \; units = 1 \tag{1}$$

In this model the physical dimensions $G, h, c, e, m_e, k_B ...$ are constructed as dimensionless geometrical forms via 2 mathematical constants to which a dimensionality is added.

The mathematical component of the physical constants is this geometrical form according to 2 dimensionless fixed numbers; the fine structure constant $\alpha$ and a recurring number labeled here $\Omega$. These forms are interlocking and so maybe defined in terms of each other, here I define LVA using MLT;

$$M = 1 \tag{2}$$

$$T = 2\pi \tag{3}$$

$$P = \Omega \tag{4}$$

$$V = \frac{2\pi P^2}{M} = 2\pi\Omega^2 \tag{5}$$

$$L = \frac{TV}{2} = 2\pi^2\Omega^2 \tag{6}$$

$$A = \frac{8V^3}{\alpha P^3} = \frac{64\pi^3\Omega^3}{\alpha} \tag{7}$$

To add dimensionality to these geometrical forms requires a dimension unit; $m$ as mass, $l$ as length, $t$ as time, $v$ as velocity, $a$ as charge, $p$ as sqrt of momentum. The base units;

$$M = (1)m, \; (mass) \tag{8}$$

$$T = (2\pi)t, \; (time) \tag{9}$$

$$P = (\Omega)p, \; (sqrt\ of\ momentum) \tag{10}$$

$$V = (2\pi\Omega^2)v, \; (velocity) \tag{11}$$

$$L = (2\pi^2\Omega^2)l, \; (length) \tag{12}$$

$$A = \left(\frac{64\pi^3\Omega^3}{\alpha}\right)a^3, \; (ampere) \tag{13}$$

However we only need 2 of these *mltvpa* units to define the others. In this example I use $(p, v)$, in the appendix I repeat using $(m, t)$ and $(a, l)$. From P and V, we can derive the rest of the constants thus;

- constant = (dimensionless $\alpha^i\Omega^j$) x (dimensionful $p^m v^n$)

Defining eq(10, 11):

$$P = (\Omega)p, \; (sqrt\ of\ momentum) \tag{14}$$

$$V = (2\pi\Omega^2)v, \; (velocity) \tag{15}$$

- $MLTA$ in terms of $p, v$;

$$T = (2\pi)\,\frac{p^{9/2}}{v^6}, \; (time) \tag{16}$$

$$M = \frac{2\pi P^2}{V} = (1)\,\frac{p^2}{v}, \; (mass) \tag{17}$$

$$L = \frac{TV}{2} = (2\pi^2\Omega^2)\,\frac{p^{9/2}}{v^5}, \; (length) \tag{18}$$

$$A = \frac{8V^3}{\alpha P^3} = \left(\frac{64\pi^3\Omega^3}{\alpha}\right)\frac{v^3}{p^3}, \; (ampere) \tag{19}$$

We next define $G, h, e, m_e, k_B ...$ in terms of $MLTVPA$;

$$G^* = \frac{V^2 L}{M} = (8\pi^4\Omega^6)\,\frac{p^{5/2}}{v^2} \tag{20}$$

$$T_P^* = \frac{AV}{\pi} = \left(\frac{128\pi^3\Omega^5}{\alpha}\right)\frac{v^4}{p^3} \tag{21}$$

$$\mu_0^* = \frac{\pi V^2 M}{\alpha L A^2} = \left(\frac{\alpha}{2048\pi^5\Omega^4}\right)p^{7/2} \tag{22}$$

$$e^* = AT = \left(\frac{128\pi^4\Omega^3}{\alpha}\right)\frac{p^{3/2}}{v^3} \tag{23}$$

$$h^* = 2\pi LVM = (8\pi^4\Omega^4)\,\frac{p^{13/2}}{v^5} \tag{24}$$

$$k_B^* = \frac{\pi VM}{A} = \left(\frac{\alpha}{32\pi\Omega}\right)\frac{p^5}{v^3} \tag{25}$$

$$\epsilon_0^* = \frac{\alpha A^2 L}{\pi V^4 M} = \left(\frac{2^9\pi^3}{\alpha}\right)\frac{1}{p^{7/2}v^2} \tag{26}$$

$$\sigma_e = \frac{3\alpha^2 AL}{\pi^2} = 384\pi^3\alpha\Omega^5\,\frac{p^{3/2}}{v^2} \tag{27}$$

$$f_e^{-1} = \frac{\sigma_e^3}{T} = 4\pi^2(2^6 3\pi^2\alpha\Omega^5)^3\; p^0 v^0 \; (p^0 v^0 = 1) \tag{28}$$

$$m_e^* = M(f_e) \tag{29}$$

$$\lambda_e^* = \left(\frac{2\pi}{f_e}\right)L \tag{30}$$

$$\alpha_G^* = f_e^2 \tag{31}$$

$$R^* = \left(\frac{m_e}{4\pi l_p \alpha^2 m_P}\right) = \frac{M(f_e)}{4\pi L\alpha^2 M} = \frac{f_e}{(2\pi\alpha)^2 L} \tag{32}$$

note, eq(29-32) suggest a Planck unit theory whereby the frequency of the Planck units are dictated by the electron function $f_e$. If the electron parameters (mass, wavelength...) are actually Planck units then $f_e$ eq(28) is the electron.

In eq(28), the magnetic monopoles $\sigma_e$ eq(27) intersect with time T eq(16) and cancel leaving units=1, a dimensionless $f_e$. We may surmise that there is a ratio of the units TAL where they overlap and cancel eq(33), in other words the units themselves are also not independent of each other but are linked to those interlocking geometrical forms.

As the units $(a, l, t)$ are interchangeable with $(m, p, v)$ we can use any equivalent ratios such as those listed below;

$$units; \; \frac{(a^3 l)^3}{t} = \frac{l^{15}}{m^9 t^{11}} = \frac{p^{15}t^2}{m^{12}} = \frac{v^{12}t^2}{p^9} = 1 \tag{33}$$

As such, we may for example define $l$ in terms of $m, t$

$$\frac{l^{15}}{m^9 t^{11}} = \frac{(m^{3/5} t^{11/15})^{15}}{(m)^9 (t)^{11}} = m^0 t^0 = 1 \quad (34)$$

$$length\ l = m^{3/5} t^{11/15} \quad (35)$$

By this means we may reduce the number of required *mltvpa* units to 2. Using any combination of valid ratios eq(33), we can simply replace MLTPV with the SI Planck unit equivalents, this means that for example if we know the numerical values for $M_{SI}$ = Planck mass $m_P$ and $T_{SI}$ = Planck time $t_p$ then we can numerically solve $L_{SI}$ = Planck length $l_p$ ... etc

$$\frac{{L_{SI}}^{15}}{{M_{SI}}^9 {T_{SI}}^{11}} = \frac{(2\pi^2\Omega^2)^{15}}{(1)^9(2\pi)^{11}}.\frac{{l_{SI}}^{15}}{{m_{SI}}^9 {t_{SI}}^{11}} = \frac{l_p^{15}}{m_P^9 t_p^{11}} = 16\pi^{19}\Omega^{30} \quad (36)$$

$$l_p^{15} = (16\pi^{19}\Omega^{30}) m_P^9 t_p^{11} \quad (37)$$

$$T_P^3 = \frac{4\pi^2 r^3}{t_p^2};\ r = \frac{2^7\pi^3\Omega^5}{\alpha} \quad (38)$$

$$\frac{\alpha\epsilon_0 m_P^4}{t_p} = (16\pi)^2 \quad (39)$$

Likewise, instead of using $kg$ and $m$ we could assign $M_{imp}$ = Planck mass in $lb$s and $L_{imp}$ = Planck length in $ft$ and thus solve the physical constants using an imperial $(m_{imp}, l_{imp})$.

$$\frac{{L_{imp}}^{15}}{{M_{imp}}^9 {T_{imp}}^{11}} = 16\pi^{19}\Omega^{30} \quad (40)$$

If we meet a non-terrestrial civilization, we need only determine 2 of their scalar units in order to solve their values for $G, h, c, e, m_e, k_B$... using their own alien system of units, i.e.;

$M_{alien} = (1)\ m_{alien}$
$T_{alien} = (2\pi) t_{alien}$
$V_{alien} = (2\pi\Omega^2) v_{alien}$
$P_{alien} = (\Omega) p_{alien}$

$$\frac{{L_{alien}}^{15}}{{M_{alien}}^9 {T_{alien}}^{11}} = 16\pi^{19}\Omega^{30} \quad (41)$$

For aliens living on a black hole we might presume default values; $m_{bh} = t_{bh} = l_{bh} = 1$.

Thus these formulas retain their meaning for all times and all cultures, even non-terrestrial and non-human ones.

In summary, I propose the physical constants are dimensionless geometrical forms to which dimensionality has been conferred, possibly via rotation. This model presumes the universe is expanding in Planck increments, thus this rotation itself may be a function of the universe expansion [9]. If the universe ceased to expand, the universe would cease to be.

These units are an integral part of the constants in that units have numerical frequencies according to the system of units used. It is not correct to write c=299792458, units=m/s because it dis-associates $m$ meters and $s$ seconds from their SI based numerical frequencies $l_{SI}$ and $t_{SI}$.

## 3 SI Units

To solve the above formulas in terms of SI units, we need to scale $(p, v)$ to the appropriate numerical values. I have placed an online calculator at http://planckmomentum.com/calc/

$\alpha$ = 137.035999139 (CODATA 2014 mean)
$\Omega$ = 2.00713494963 (best fit)
$v$ = 11843707.85 (best fit)
$p$ = .50774534108 (best fit)

As only 2 units are required, we can also define our least accurate constants in terms of our most accurate, here I use the permeability of vacuum $\mu_0$ and $c$ (exact values) and the Rydberg constant $R$ (12-13 digit precision).

We first determine which ratios of $(c^*, \mu_0^*, R^*)$ eq(11, 22, 32) will give the same geometrical solution as for each constant $(G^*, h^*...)$ respectively. We then replace $(c^*, \mu_0^*, R^*, \alpha)$ with the CODATA values for $(c, \mu_0, R, \alpha)$, see table p1.

$$c^* = (2\pi\Omega^2)v,\ (SI = \frac{m}{s}) \quad (42)$$

$$\mu_0^* = \left(\frac{\alpha}{2048\pi^5\Omega^4}\right) p^{7/2},\ (SI = \frac{kg.m}{s^2 A^2}) \quad (43)$$

$$R^* = \frac{f_e}{(2\pi\alpha)^2 L} = \frac{1}{2^{23}3^3\pi^{11}\alpha^5\Omega^{17}}\frac{v^5}{p^{9/2}},\ (SI = 1/m) \quad (44)$$

$R$ = 10973731.568508 (CODATA 2014 mean)

Planck constant (eq.24)
$h$ = .662 606 913 413 e-33 (see table p1)

$$(h^*)^3 = (8\pi^4\Omega^4\ \frac{p^{13/2}}{v^5})^3 \quad (45)$$

$$\frac{2\pi^{10}\mu_0^{*3}}{3^6 c^{*5}\alpha^{13} R^{*2}} = (8\pi^4\Omega^4\ \frac{p^{13/2}}{v^5})^3 \quad (46)$$

$$h^3 = \frac{2\pi^{10}\mu_0^3}{3^6 c^5 \alpha^{13} R^2}\ (units = \frac{p^{39/2}}{v^{15}}) \quad (47)$$

Elementary charge (eq.23)
$e$ = .160 217 651 130 e-18

$$e^3 = \frac{4\pi^5}{3^3 c^4 \alpha^8 R}\ (units = \frac{p^{9/2}}{v^9}) \quad (48)$$

) Boltzmann constant (eq.25)
$k_B$ = .137 951 014 752 e-22

$$k_B^3 = \frac{\pi^5\mu_0^3}{3^3 2 c^4 \alpha^5 R}\ (units = \frac{p^{15}}{v^9}) \quad (49)$$

Gravitation constant (eq.20)
$G$ = .667 249 719 229 e-10

$$G^5 = \frac{\pi^3\mu_0}{2^{20}3^6\alpha^{11}R^2}\ (units = \frac{p^{25/2}}{v^{10}}) \quad (50)$$

Electron mass (eq.29)
$m_e^*$ = .910 938 231 256 e-30

$$m_e^3 = \frac{16\pi^{10} R \mu_0^3}{3^6 c^8 \alpha^7}\ (units = \frac{p^{30}}{v^{15}}) \quad (51)$$

## 4 Sqrt of Planck momentum

I have premised that the sqrt of momentum $P$ is a link between mass and charge. Denoting the sqrt of Planck momentum with the letter $Q$ ($P_{SI} = Q$) such that the SI unit Planck momentum = $2\pi Q^2$, units = (kg.m/s)

$$Q = 1.019\ 113...\ units = \sqrt{\frac{kg.m}{s}} \quad (52)$$

In this section I derive this model using SI constants and Q.
4.1. The mass constants in terms of $Q^2, c, l_p$;

$$m_P = \frac{2\pi Q^2}{c} \quad (53)$$

$$G = \frac{l_p c^3}{2\pi Q^2} \quad (54)$$

$$h = 2\pi Q^2 2\pi l_p \quad (55)$$

$$t_p = \frac{2l_p}{c} \quad (56)$$

$$F_p = \frac{E_p}{l_p} = \frac{2\pi Q^2}{t_p} \quad (57)$$

4.2. The charge constants in terms of $Q^3, c, \alpha, l_p$;

$$A_Q = \frac{8c^3}{\alpha Q^3} \quad (58)$$

$$e = AT = \frac{8c^3}{\alpha Q^3}.\frac{2l_p}{c} = \frac{16 l_p c^2}{\alpha Q^3} \quad (59)$$

$$T_p = \frac{AV}{\pi} = \frac{8c^3}{\alpha Q^3}.\frac{c}{\pi} = \frac{8c^4}{\pi\alpha Q^3} \quad (60)$$

$$k_B = \frac{E_p}{T_p} = \frac{\pi^2\alpha Q^5}{4c^3} \quad (61)$$

4.3. The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to exactly $2.10^{-7}$ newton per meter of length.

$$\frac{F_{electric}}{A_Q^2} = \frac{2\pi Q^2}{\alpha t_p}.(\frac{\alpha Q^3}{8c^3})^2 = \frac{\pi\alpha Q^8}{64 l_p c^5} = \frac{2}{10^7} \quad (62)$$

$$\mu_0 = \frac{\pi^2\alpha Q^8}{32 l_p c^5} = \frac{4\pi}{10^7} \quad (63)$$

4.4. Planck length $l_p$ in terms of $Q, c, \alpha, \mu_0$;

$$l_p = \frac{\pi^2\alpha Q^8}{32\mu_0 c^5} \quad (64)$$

$$\mu_0 = 4\pi.10^{-7}$$

$$l_p = \frac{5^7\pi\alpha Q^8}{c^5} \quad (65)$$

Replacing Planck length with eq(64) gives;

$$h = 2\pi Q^2 2\pi l_p = \frac{2^2 5^7\pi^3\alpha Q^{10}}{c^5} \quad (66)$$

$$e = \frac{16 l_p c^2}{\alpha Q^3} = \frac{2^4 5^7\pi Q^5}{c^3} \quad (67)$$

$$G = \frac{l_p c^3}{2\pi Q^2} = \frac{5^7\alpha Q^6}{2c^2} \quad (68)$$

Von Klitzing constant in terms of $c, \alpha$;

$$R_K = \frac{h}{e^2} = \frac{\pi\alpha c}{5000000} \quad (69)$$

4.5. A magnetic monopole in terms of $Q, c, \alpha, l_p$;

The ampere-meter is the SI unit for pole strength (the product of charge and velocity) in a magnet ($Am = ec$). A magnetic monopole $\sigma_e$ is a hypothetical particle that is a magnet with only 1 pole [10]. A proposed monopole $\sigma_e$.

$$\sigma_e = \frac{2\pi^2}{3\alpha^2 ec} \quad (70)$$

The electron function $f_e$;

$$f_e = t_p\sigma_e^3 = \frac{\pi^6 Q^9}{2^8 3^3\alpha^3 l_p^2 c^{10}} \quad (71)$$

Electron mass:

$$m_e = m_P f_e \quad (72)$$

Electron wavelength:

$$\lambda_e = \frac{2\pi l_p}{f_e} \quad (73)$$

Gravitation coupling constant:

$$\alpha_G = (\frac{m_e}{m_P})^2 = f_e^2 \quad (74)$$

Magnetic Induction

$$B_e = \frac{m_P}{\alpha^2 A_Q t_p^2} f_e^2 \quad (75)$$

4.6. Rydberg constant $R_\infty$

$$R_\infty = \frac{m_e e^4\mu_0^2 c^3}{8h^3} = \frac{2^5 c^5\mu_0^3}{3^3\pi\alpha^8 Q^{15}} \quad (76)$$

The Rydberg constant $R_\infty$ = 10973731.568508(65) [14] with a 12-13 digit precision is the most accurate of the natural constants. The known precision of Planck momentum and so Q is low, however with the solution for the Rydberg constant eq(75) we may now rationalize Q (and $l_p$) in terms of the 4 most accurate constants; $c$, $\mu_0$ (exact values), $R$ and $\alpha$;

$$Q^{15} = \frac{2^5 c^5 \mu_0^3}{3^3 \pi \alpha^8 R} \tag{77}$$

$$l_p = \frac{\pi^2 \alpha Q^8}{32 \mu_0 c^5} \tag{78}$$

for example;

$$e = \frac{16 l_p c^2}{\alpha Q^3} = \frac{\pi^2 Q^5}{2 \mu_0 c^3} \tag{79}$$

$$e^3 = \frac{\pi^6 Q^{15}}{8 \mu_0^3 c^9} = \frac{4\pi^5}{3^3 c^4 \alpha^8 R} \tag{80}$$

## 5 Appendix

- Electron function $f_e = 2.389545246x10^{23}$
  magnetic-monopole electric-state (analog)
  - time (duration) = $2.389545246x10^{23} t_p$
  - mass = 0
  mathematical point-state (digital)
  - time (duration) = $1 t_p$
  - mass =$1 m_P$

electron mass $m_e$ becomes a measure of the frequency of occurrence of the point-state per second, consequently $hv = mc^2$ as $hv$ is a measure of the frequency of the electric-state.

The gravitation coupling constant suggests that gravity is a point-state to point-state interaction, as such gravity has the same magnitude as the strong force, it appears weak only because it seldom occurs, the probability that 2 electrons will be simultaneously in the gravity/mass point state = $1/\alpha_G^* = 1/{f_e}^2$, which is about once a minute. If the point-state is a Planck mass black-hole then gravity becomes a black-hole to black-hole interaction. As there are only discrete (integer) black-holes (there is no 1/2 a black-hole), then measured gravity is the sum of these discrete interactions.

- Omega:
The CODATA mean $\alpha$ gives $\Omega = 2.00713494963$. There is a close natural number solution for Omega;

$$\Omega = \sqrt{\left(\frac{\pi^e}{e^{(e-1)}}\right)} = 2.0071349543249... \tag{81}$$

This solution is not required by the model, I note it partly for its resemblance to Euler's formula, considered by Richard Feynman to be "the most remarkable formula in mathematics" [7], but more principally that it is a square root solution $P = (\Omega)$ and I have proposed that $P$ as the sqrt of momentum is the link between mass and charge whereby in all charge related formulas Omega occurs in the form $\Omega^3$ and $\Omega^5$ and in mass related formulas as an integer $\Omega^2$. Furthermore this model presumes a universe expansion in integer steps [9] and as both $\pi$ and $e$ maybe be constructed from an integer series, this solution for $\Omega$ could be naturally occurring.

- To solve the SI value for $v$ I used $c$, to solve $p$ and $\Omega$ I also used $R$ eq(32, 76) and $\mu_0$ eq(22);

$$V_{SI} = (2\pi\Omega^2) v = c, \; v = \frac{c}{2\pi\Omega^2} \tag{82}$$

$$p^{7/2} = \frac{2048 \pi^5 \Omega^4 \mu_0}{\alpha} \tag{83}$$

$$p^{9/2} = \frac{c^5}{2^{28} 3^3 \pi^{16} \Omega^{27} \alpha^5 R} \tag{84}$$

$$P_{SI} = (\Omega) p = Q, \; p = \frac{Q}{\Omega} \tag{85}$$

$$Q = \frac{c^5}{2^{39} 3^3 \pi^{21} \Omega^{30} \alpha^4 \mu_0 R} \tag{86}$$

$$Q^{15} = \frac{2^5 c^5 \mu_0^3}{3^3 \pi \alpha^8 R} \tag{87}$$

We can thus define $\alpha$ and $\Omega$ in terms of known constants;

$$\Omega^{225} \alpha^{26} = \frac{c^{35}}{2^{295} 3^{21} \pi^{157} \mu_0^9 R^7} \tag{88}$$

- Constants in terms of mass and time $m, t$
  $m_{SI}$ = .217672817580...e-7 kg;
  $t_{SI}$ = .171585512841...e-43 s;
  $M = (1)m, (mass)$
  $T = (2\pi)t, (time)$

$$P = (\Omega)\, \frac{m^{4/5}}{t^{2/15}}, \; (sqrt\ of\ momentum) \tag{89}$$

$$V = \frac{2\pi P^2}{M} = (2\pi\Omega^2)\, \frac{m^{3/5}}{t^{4/15}}, \; (velocity) \tag{90}$$

$$L = \frac{TV}{2} = (2\pi^2\Omega^2)\, m^{3/5} t^{11/15}, \; (length) \tag{91}$$

$$A = \frac{8V^3}{\alpha P^3} = \left(\frac{64\pi^3\Omega^3}{\alpha}\right) \frac{1}{m^{3/5} t^{2/5}}, \; (ampere) \tag{92}$$

$$G^* = \frac{V^2 L}{M} = (8\pi^4\Omega^6)\, m^{4/5} t^{1/5} \tag{93}$$

$$T_P^* = \frac{AV}{\pi} = \left(\frac{128\pi^3\Omega^5}{\alpha}\right) \frac{1}{t^{2/3}} \tag{94}$$

$$\mu_0^* = \frac{\pi V^2 M}{\alpha L A^2} = \left(\frac{\alpha}{2048\pi^5\Omega^4}\right) \frac{m^{14/5}}{t^{7/15}} \tag{95}$$

$$e^* = AT = \left(\frac{128\pi^4\Omega^3}{\alpha}\right) \frac{t^{3/5}}{m^{3/5}} \tag{96}$$

$$h^* = 2\pi LVM = (8\pi^4\Omega^4)\, m^{11/5} t^{7/15} \tag{97}$$

$$k_B^* = \frac{\pi VM}{A} = \left(\frac{\alpha}{32\pi\Omega}\right) m^{11/5} t^{2/15} \tag{98}$$

$$c, \; units = \frac{m^{3/5}}{t^{4/15}} = \frac{m}{s} \tag{99}$$

$$\mu_0,\ units = \frac{m^{14/5}}{t^{7/15}} = \frac{kg.m}{s^2A^2} \tag{100}$$

$$(R^{-1}),\ units = m^{3/5}t^{11/15} = m \tag{101}$$

Planck constant

$$h^3 = \frac{2\pi^{10}\mu_0^3}{3^6c^5\alpha^{13}R^2},\ units = m^{33/5}t^{7/5} \tag{102}$$

Elementary charge

$$e^3 = \frac{4\pi^5}{3^3c^4\alpha^8R},\ units = \frac{t^{9/5}}{m^{9/5}} \tag{103}$$

Boltzmann constant

$$k_B^3 = \frac{\pi^5\mu_0^3}{3^32c^4\alpha^5R},\ units = m^{33/5}t^{2/5} \tag{104}$$

Gravitation constant

$$G^5 = \frac{\pi^3\mu_0}{2^{20}3^6\alpha^{11}R^2},\ units = m^4t \tag{105}$$

Electron mass

$$m_e^3 = \frac{16\pi^{10}R\mu_0^3}{3^6c^8\alpha^7},\ units = m^3 \tag{106}$$

- Constants in terms of ampere and length $a, l$

$a_{SI}$ = 23326078.8267a

$l_{SI}$ = .203220881958e-36m

$$A = \left(\frac{64\pi^3\Omega^3}{\alpha}\right) a^3,\ (ampere) \tag{107}$$

$$L = (2\pi^2\Omega^2)\ l,\ (length) \tag{108}$$

$$T = (2\pi)\ l^3a^9,\ (time) \tag{109}$$

$$V = \frac{2L}{T} = (2\pi\Omega^2)\ \frac{1}{l^2a^9},\ (velocity) \tag{110}$$

$$M = \frac{8\pi V}{\alpha^{2/3}A^{2/3}} = (1)\frac{1}{l^2a^{11}},\ (mass) \tag{111}$$

$$G^* = \frac{V^2L}{M} = (8\pi^4\Omega^6)\ \frac{1}{la^7} \tag{112}$$

$$T_P^* = \frac{AV}{\pi} = \left(\frac{128\pi^3\Omega^5}{\alpha}\right)\ \frac{1}{l^2a^6} \tag{113}$$

$$\mu_0^* = \frac{\pi V^2M}{\alpha LA^2} = \left(\frac{\alpha}{2048\pi^5\Omega^4}\right)\ \frac{1}{l^7a^{35}} \tag{114}$$

$$e^* = AT = \left(\frac{128\pi^4\Omega^3}{\alpha}\right)\ l^3a^{12} \tag{115}$$

$$h^* = 2\pi LVM = (8\pi^4\Omega^4)\ \frac{1}{l^3a^{20}} \tag{116}$$

$$k_B^* = \frac{\pi VM}{A} = \left(\frac{\alpha}{32\pi\Omega}\right)\ \frac{1}{l^4a^{23}} \tag{117}$$

$$\epsilon_0^* = \frac{\alpha A^2L}{\pi V^4M} = \left(\frac{2^9\pi^3}{\alpha}\right)\ l^{11}a^{53} \tag{118}$$

$$\sigma_e = \frac{3\alpha^2AL}{\pi^2}\ la^3 \tag{119}$$

$$f_e^{-1} = \frac{\sigma_e^3}{T} = 4\pi^2(2^63\pi^2\alpha\Omega^5)^3\ l^0a^0 \tag{120}$$

$$c,\ units = \frac{1}{l^2a^9},\ (\frac{m}{s}) \tag{121}$$

$$\mu_0,\ units = \frac{1}{l^7a^{35}},\ (\frac{kg.m}{s^2A^2}) \tag{122}$$

$$R,\ units = \frac{1}{l},\ (\frac{1}{m}) \tag{123}$$

Planck constant

$$h^3 = \frac{2\pi^{10}\mu_0^3}{3^6c^5\alpha^{13}R^2},\ units = \frac{1}{l^9a^{60}} \tag{124}$$

Elementary charge

$$e^3 = \frac{4\pi^5}{3^3c^4\alpha^8R},\ units = l^9a^{36} \tag{125}$$

Boltzmann constant

$$k_B^3 = \frac{\pi^5\mu_0^3}{3^32c^4\alpha^5R},\ units = \frac{1}{l^{12}a^{69}} \tag{126}$$

Gravitation constant

$$G^5 = \frac{\pi^3\mu_0}{2^{20}3^6\alpha^{11}R^2},\ units = \frac{1}{l^5a^{35}} \tag{127}$$

Electron mass

$$m_e^3 = \frac{16\pi^{10}R\mu_0^3}{3^6c^8\alpha^7},\ units = \frac{1}{l^6a^{33}} \tag{128}$$

Planck time

$$t_p^{15} = \frac{\pi^{22}\mu_0^9}{2^{20}3^{24}c^{50}\alpha^{49}R^8}, units = l^{45}a^{135} \tag{129}$$

Planck mass

$$m_P^{15} = \frac{2^{25}\pi^{13}\mu_0^6}{3^6c^5\alpha^{16}R^2},\ units = \frac{1}{l^{30}a^{165}} \tag{130}$$

- Miscellaneous formulas in terms of Q;

$$\alpha = \frac{2h}{\mu_0e^2c} = 2.2\pi Q^22\pi l_p.\frac{32l_pc^5}{\pi^2\alpha Q^8}.\frac{\alpha^2Q^6}{256l_p^2c^4}.\frac{1}{c} = \alpha \tag{131}$$

$$c = \frac{1}{\sqrt{\mu_0\epsilon_0}};\ \mu_0\epsilon_0 = \frac{\pi^2\alpha Q^8}{32l_pc^5}\ \frac{32l_pc^3}{\pi^2\alpha Q^8} = \frac{1}{c^2} \tag{132}$$

$$E_n = -\frac{2\pi^2k_e^2m_ee^4}{h^2n^2} = -\frac{m_ec^2}{2\alpha^2n^2} \tag{133}$$

$$E_n = -2\pi^2 \frac{\pi^2\alpha^2 Q^{16}}{16384 l_p^2 c^6} m_e \frac{65536 l_p^4 c^8}{\alpha^4 Q^{12}} \frac{1}{4\pi^2 Q^4 4\pi^2 l_p^2} \quad (134)$$

$$q_p = \sqrt{4\pi\epsilon_0 \hbar c} = \sqrt{4\pi \frac{32 l_p c^3}{\pi^2 \alpha Q^8} 2\pi Q^2 l_p\, c} = \sqrt{\alpha} e \quad (135)$$

$$r_e = \frac{e^2}{4\pi\epsilon_0 m_e c^2} = \frac{256 l_p^2 c^4}{\alpha^2 Q^6} \frac{1}{4\pi} \frac{\pi^2 \alpha Q^8}{32 l_p c^3} \frac{1}{m_e c^2} = \frac{l_p m_P}{\alpha m_e} \quad (136)$$

$$\frac{4\pi\epsilon_0 G m_e m_p}{e^2} = 4\pi \frac{32 l_p c^3}{\pi^2 \alpha Q^8} \frac{l_p c^3}{2\pi Q^2} m_e m_p \frac{\alpha^2 Q^6}{256 l_p^2 c^4} = \frac{\alpha m_e m_p}{m_P^2} \quad (137)$$

$$m_P = \frac{B^2 r^2 e^2}{2 E_p} = \frac{\pi^2 \alpha^2 Q^{10}}{64 l_p^4 c^4} l_p^2 \frac{256 l_p^2 c^4}{\alpha^2 Q^6} \frac{1}{2\pi Q^2 c} = \frac{2\pi Q^2}{c} \quad (138)$$

## 6 Notes

This essay has been adapted from the book Plato's Cave [6]

Richard Feynman on the fine-structure constant alpha:

There is a most profound and beautiful question associated with the observed coupling constant... It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it. Immediately you would like to know where this number for a coupling comes from: is it related to pi or perhaps to the base of natural logarithms e? Nobody knows. It's one of the greatest damn mysteries of physics: a magic number that comes to us with no understanding by man. You might say the "hand of God" wrote that number, and "we don't know how He pushed his pencil." ... [11]

A *charged rotating black hole* is a black hole that possesses angular momentum and charge. In particular, it rotates about one of its axes of symmetry. In physics, there is a speculative notion that if there were a black hole with the same mass and charge as an electron, it would share many of the properties of the electron including the magnetic moment and Compton wavelength. This idea is substantiated within a series of papers published by Albert Einstein between 1927 and 1949. In them, he showed that if elementary particles were treated as singularities in spacetime, it was unnecessary to postulate geodesic motion as part of general relativity [12].

The Dirac–Kerr–Newman black-hole electron was introduced by Burinskii using geometrical arguments. The Dirac wave function plays the role of an order parameter that signals a broken symmetry and the electron acquires an extended space-time structure. Although speculative, this idea was corroborated by a detailed analysis and calculation [5].

*Wave–particle duality* is the concept that every elementary particle or quantic entity may be partly described in terms not only of particles, but also of waves. It expresses the inability of the classical concepts "particle" or "wave" to fully describe the behavior of quantum-scale objects.

J. Barrow and J Webb in their 2005 Scientific American article on the fundamental constants wrote;

'Some things never change. Physicists call them the *constants of nature*. Such quantities as the velocity of light, $c$, Newton's constant of gravitation, $G$, and the mass of the electron, $m_e$, are assumed to be the same at all places and times in the universe. They form the scaffolding around which the theories of physics are erected, and they define the fabric of our universe. Physics has progressed by making ever more accurate measurements of their values. And yet, remarkably, no one has ever successfully predicted or explained any of the constants. Physicists have no idea why they take the special numerical values that they do. In SI units, $c$ is 299,792,458; $G$ is 6.673e-11; and $m_e$ is 9.10938188e-31 -numbers that follow no discernible pattern. The only thread running through the values is that if many of them were even slightly different, complex atomic structures such as living beings would not be possible.

The desire to explain the constants has been one of the driving forces behind efforts to develop a complete unified description of nature, or "theory of everything". Physicists have hoped that such a theory would show that each of the constants of nature could have only one logically possible value. It would reveal an underlying order to the seeming arbitrariness of nature.' [3]

There are two kinds of fundamental constants of Nature: dimensionless (alpha) and dimensionful (c, h, G). To clarify the discussion I suggest to refer to the former as fundamental parameters and the latter as fundamental (or basic) units. It is necessary and sufficient to have three basic units in order to reproduce in an experimentally meaningful way the dimensions of all physical quantities. Theoretical equations describing the physical world deal with dimensionless quantities and their solutions depend on dimensionless fundamental parameters. But experiments, from which these theories are extracted and by which they could be tested, involve measurements, i.e. comparisons with standard dimensionful scales. Without standard dimensionful units and hence without certain conventions physics is unthinkable -*Trialogue* [2].

L. and J. Hsu have argued that the fundamental constants divide into two categories, units-independent (*category A*), and units-dependent (*category B*), because only constants in the former category have values that are not determined by the human convention of units and so are true fundamental constants in the sense that they are inherent properties of our universe. In comparison, constants in the latter category are not fundamental constants in the sense that their particular values are determined by the human convention of units [1].

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18. Electron charge
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19. Vacuum of permeability
    http://physics.nist.gov/cgi-bin/cuu/Value?mu0
20. Gravitation constant
    http://physics.nist.gov/cgi-bin/cuu/Value?bg
21. Boltzmann constant
    http://physics.nist.gov/cgi-bin/cuu/Value?k
22. Von Klitzing constant
    http://physics.nist.gov/cgi-bin/cuu/Value?rk
23. Larmor frequency
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